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Shifting attention between the space of the body and external space

Electrophysiological correlates of visual-nociceptive crossmodal spatial attention

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Introduction

The ability to localize nociceptive stimuli depends partially on a somatotopic representation of the bodily space, but requires also **integration** of information conveyed through nociceptive afferents and inputs from other sensory systems (Legrain et al., Prog Neurobiol 2011).

➔ spatial attention needs to be coordinated across the different senses to form a **crossmodal link** between different dimensions of space.
➔ effective localization of bodily threats requires orienting selectively attention toward the part of the body in pain but also in external space.

There are many studies of crossmodal **links** between vision and touch, but not **between vision and nociception in orientation of spatial attention.**

We hypothesize that the occurrence of a nociceptive stimulus on a given body part is able to shift spatial attention in external space in order to improve the processing of visual stimuli delivered close to the stimulated body part.
➔ the magnitude of ERPs to visual stimuli should be enhanced and performance in the visual task improved by spatial validity of a nociceptive cuing stimuli.

Methods

- 10 healthy volunteers (24.5±2.8 years)
- 8 blocks (60 trials per block) of a crossmodal cuing paradigm (**Figure 1**) :
(1) Nociceptive stimuli (intraepidermal electrical stimulation) applied randomly on one of the two hands.
(2) After 800 ms, a visual stimulus (LED) is delivered, at the location adjacent to the stimulated hand (70% **validly cued** trials) or adjacent to the other hand (30% **invalidly cued** trials).
- Participants have to respond as fast as and as accurately as possible to the occurrence of the target stimulus (double flash, 1/3 of trials) and not to the nontarget stimulus (single flash, 2/3 of trials).

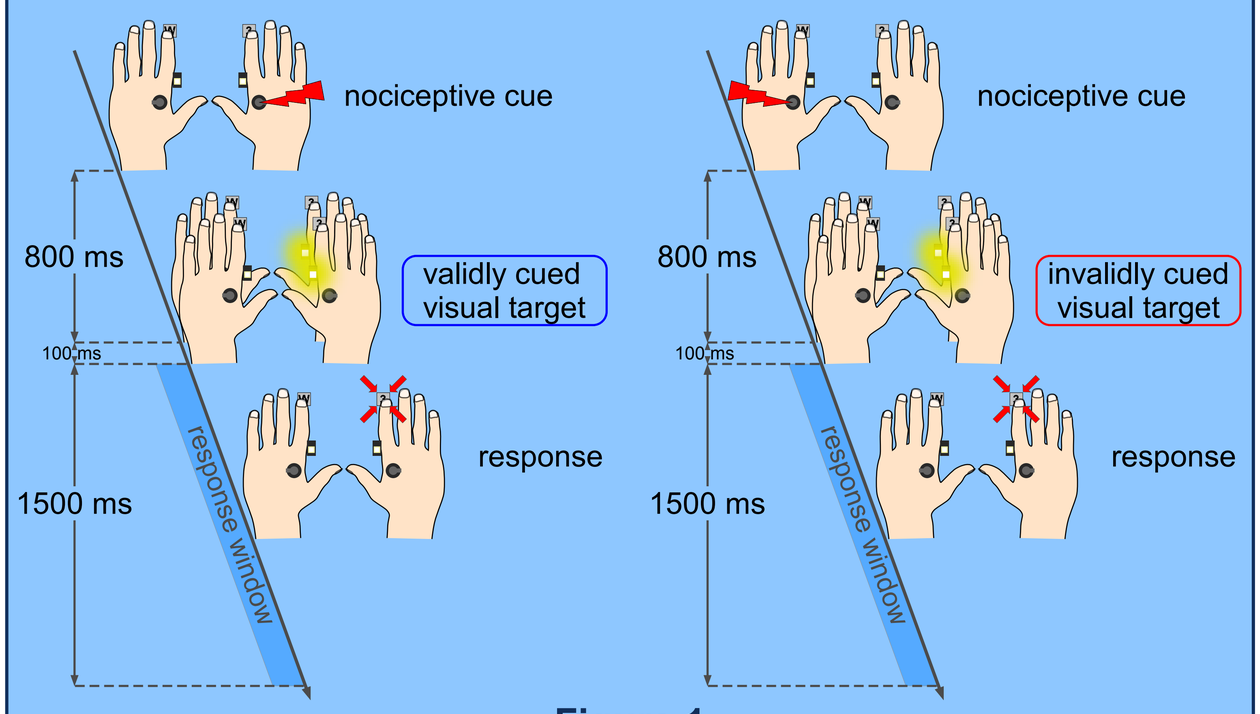

Figure 1

Results

(1) In the visual task, there was a significant effect of the validity of the nociceptive cue on reaction time (RT): shorter RTs to visual targets preceded by a valid nociceptive cue than to a target preceded by an invalid cue.

(2) For the **nontarget visual stimuli**, the amplitude of ERP components N1, P2 and N2 was more negative when visual stimuli appeared on the validly cued side as compared to the invalidly cued side (**Figure 2**).
The earlier and later components of visual ERPs were not affected by the location of the nociceptive cue. There were no effects on the latencies of the visual ERPs.

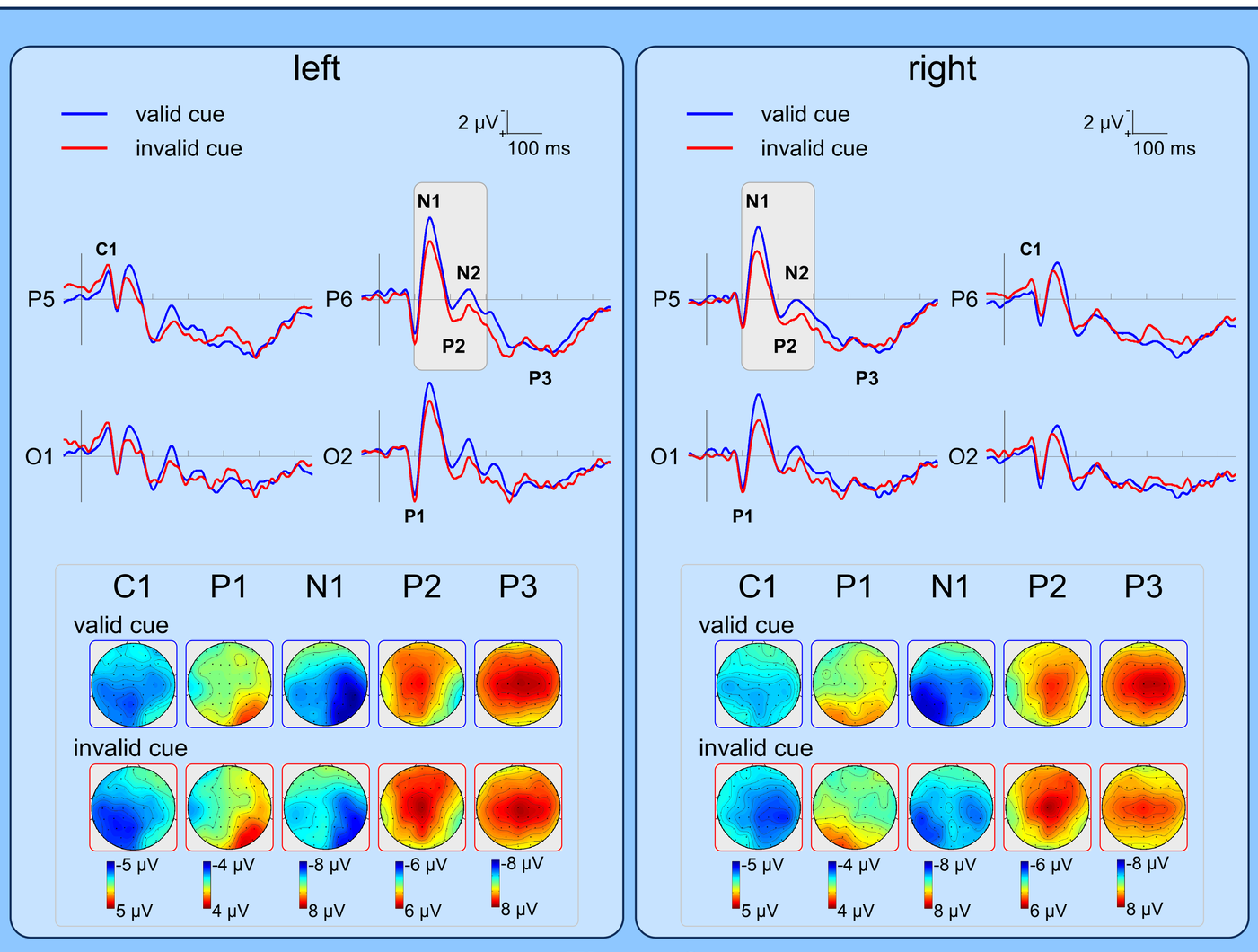

Figure 2

Conclusion

Nociceptive stimuli can orient attention toward the space around the stimulated part of the body in order to facilitate the processing of visual stimuli occurring close to that body part. This effect could be supported by a common frame of reference able to coordinate the mapping of both the body space and the external proximal space.

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